

2015 International Workshop on Evapotranspiration Mapping for Water Security

Sponsored by NASA and the World Bank

September 15, 16, and 17

The World Bank
1818 H St NW, Washington, DC

Evapotranspiration (ET) is the primary consumer of fresh water and is essential to understanding the hydrologic cycle and impacts of water diversion, storage, and use at local, regional, and global scales. Within the last several decades, there have been great advances in our ability to compute and map ET over large areas through the use of satellite-based remote sensing and geospatial models. The NASA Applied Sciences Program Water Resources Application Area and the World Bank are co-sponsoring the 2015 International Workshop on Evapotranspiration Mapping for Water Security to further advance the use of these ET tools. The workshop is free and open to the water resources community, but registration is limited to 150 participants.

Time and Location

September 15-17, 2015, in the Preston Auditorium (9/15 and 9/16) and Room MC 2-800 (9/17), The World Bank, 1818 H St. NW, Washington, DC.

Objectives

- 1) Raise awareness among U.S. and international water resource managers and other stakeholders of the potential benefits of using satellite-based mapping of ET.
- 2) Highlight successful U.S. and international examples of operational water resource management applications that use remotely sensed ET in decision-making from the field to regional scales, emphasizing the benefits and impacts for water resource management.
- 3) Identify opportunities to increase the use of satellite-based mapping of ET to enhance water resource security and sustainability in the U.S. and internationally.
- 4) Identify constraints on expanded use of remote sensing of ET, for example due to relatively low numbers and revisit frequencies of current field-scale satellite systems. Identify current challenges and existing barriers to use of remotely sensed ET internationally.
- 5) Identify information needs and data requirements from the water resources and ET user communities to inform planning for future satellite missions, including requirements for accuracy, spatial resolution, and revisit frequency.
- 6) Facilitate coordination with the World Bank, USAID, and other agencies to develop a strategy for international research and applied science partnerships to address existing challenges and accelerate the use of remotely sensed ET in water resources management.



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Meeting Overview

Day 1 will describe the major approaches for developing ET datasets and maps, the requirements and limitations of current satellite revisit times and spatial scales, and the important attributes of remote sensing systems. These will be discussed in the context of impacts on water management and market-driven water transfers.

Day 2 of the workshop will review examples of recent and ongoing work in the U.S., China, Africa, Brazil, and other countries to apply satellite-based estimates of ET to improve monitoring and management of agricultural water resources, and resolve disputes over water distribution and water rights. Discussions will focus on identifying near-term opportunities to apply this technology to achieve improvements in water resources management, project planning and operations, and food production. Participants will discuss strategies to realize in-country investments in ground-based meteorological networks, validation campaigns, computing infrastructure for data access, and technical training.

Day 3 will highlight emerging technologies for ET mapping, and will also include an important half-day workshop during which attendees will develop specific recommendations to inform investments in future research and applied science activities, as well as planning for future satellite systems.

We plan to provide opportunity for all attendees to bring stand-alone posters to the workshop that can be displayed during the workshop.

Registration

The Workshop will have **no registration fee** and is open to the water resources community but seating is limited. Drop-in attendees are welcome, but all potential attendees should pre-register to minimize on-site time required by security procedures at the World Bank. Please register on-line at: <http://tinyurl.com/IntlET2015>

Agenda

Updated information on the workshop agenda, speakers, topics, and travel and logistics is available on-line at: <https://c3.nasa.gov/water/resources/10/>



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Day 1 Success to Date: ET Applications in the United States

Preston Auditorium, World Bank

- 07:30 – 08:15 *Visitor badging and workshop registration*
- 08:15 – 08:30 *Welcome and Opening Remarks*, Bradley Doorn, NASA HQ; N. Harshadeep, World Bank; John Tracy, University of Idaho
- 08:30 – 09:00 *Organization and Goals of the Workshop*, Forrest Melton, NASA ARC-CREST
- Why ET matters – The Importance of ET Mapping for Water Resources Management*, Tony Willardson, Western States Water Council

Session 1 – Operational Applications using Remotely Sensed ET in Decision-Making from Field to Regional Scales

- 09:00 – 09:20 *Field-Scale ET Applications in Water Rights Management: Why Thermal? Why Field-Scale? Why more 30 m Satellites?* (Rick Allen, Univ. Idaho)
- 09:20 – 09:40 *National-Scale ET Mapping: Operational Production and Use at NOAA*, Martha Anderson, USDA-ARS and Chris Hain, NOAA
- 09:40 – 10:00 *USGS Support for Remote Sensing of ET: Methods for the US Water Census, Accuracy Needs, and Intercomparisons*, Jim Verdin, USGS
- 10:00 – 10:15 Discussion and Questions
- 10:15 – 10:30 **Coffee Break**
- 10:30 – 10:45 *Satellite-based ET Applications in the Upper Colorado and Green River*, Steve Wolff, Wyoming State Engineer's Office
- 10:45 – 11:00 *Use of METRIC-based ET Estimates as a Basis for Settling a Water Rights Conflict over In-stream Flows and Irrigation Diversions Among an Indian Tribe, the United States, and Private Ranchers in Oregon*, Larry Dunsmoor, Klamath Tribes
- 11:00 – 11:15 *Monitoring perennial yield and capture of natural groundwater discharge with the Landsat archive*, Justin Huntington, Desert Research Institute
- 11:15 – 11:30 *ET Mapping on the Great Plains: Support of Conjunctive Management of Ground Water and Surface Water*, Duane Woodward, Central Platte Natural Resources District, Grand Island



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- 11:30 – 11:45 *Issues in Evaluating ET Model Output Using Measurements and Model Intercomparisons*, Bill Kustas, USDA ARS
- 11:45 – 12:15 Discussion and Questions
- 12:15 – 01:30 **Lunch**

Session 2 – Operational Applications using Remotely Sensed ET in Decision-Making from Field to Regional Scales (continued)

- 01:30 – 01:45 *How can Growers Use ET Information in Irrigation Management: Opportunities and Challenges* (Sonia Salas, Western Growers Association)
- 01:45 – 02:00 *Operational Applications of ET Mapping in California* (Forrest Melton and Lee Johnson, NASA ARC-CREST)
- 02:00 – 02:15 *Satellite-based ET Applications in Wine Production: Maintaining Quality and Quantity in the Face of Drought*, Martin Mendez-Costabel, E. & J. Gallo
- 02:15 – 02:30 *Gridded Weather and Reference ET Data for US and Global ET Mapping*, Mike Hobbins, NOAA
- 02:30 – 02:45 *Overview of US National ET Gridded Products (TBD)*
- 02:45 – 03:00 *EEFlux: Landsat-based ET on the Google Earth Engine and Use of METRIC-based Diagnostic ET from MODIS to Assess ET simulated by Weather Research Forecast – Land Simulation Models*, Ayse Kilic and Doruk Ozturk, Univ. Nebraska, Rick Allen, University of Idaho
- 03:00 – 03:15 Discussion and Questions
- 03:15 – 03:45 **Coffee Break**

Session 3 – Future Satellite Missions and Opportunities

- 03:45 – 04:00 *Status of Current and Future Earth Observation Satellites to Support Water and Food Management*, Brad Doorn, NASA HQ
- 04:00 – 04:15 *Overview of the ECOSTRESS Mission*, Josh Fisher, NASA JPL
- 04:15 – 04:30 *Additional ET Observation Platforms: Towards an Integrated Observation Capability*, Rick Allen, University of Idaho
- 04:30 – 04:45 *How do USGS and NASA Communicate with Stakeholders?* Tim Newman, USGS HQ, Brad Doorn, NASA HQ



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- 04:45 – 05:00 *Sustaining Agricultural Water Supplies in the US: Congressional Perspectives on Water Security*, Tim Petty, Deputy Legislative Director for Senator James Risch
- 05:00 – 05:15 Discussion and Questions
- 05:15 – 05:30 Introduction of a straw man white paper on future needs for field-scale observation of ET (For discussion on Day 3), Rick Allen, University of Idaho

Day 2 International ET Applications

Preston Auditorium, World Bank

- 08:00 – 8:30 Visitor badging and registration
- 08:30 – 08:45 *Opening Remarks*
- Jennifer J. Sara, Director, Water Global Practice, World Bank
- Bilal H. Rahill, Director, Environment and Natural Resources, World Bank
- Michael Freilich, Director, Earth Science Division, NASA (*invited*)
- 08:45 – 09:00 *Development Context*, N. Harshadeep and Rita Cestti, World Bank
- 09:00 – 10:00 International Case Studies and Capabilities
- Overview of ET Mapping Approaches and Highlights from Day 1*, Forrest Melton, NASA ARC-CREST
- Water Accounting and the Need for Global Ensemble ET Data Products*, Wim Bastiaanssen, UNESCO-IHE
- ET Mapping in China*, Bing Fang Wu, Chinese Academy of Sciences
- 10:00 – 10:30 Discussion and Questions
- 10:30 – 11:00 Coffee Break
- 11:00 – 12:00 International Case Studies and Capabilities (cont'd).
- Sentinels for Agricultural Monitoring – the Case of Irrigation*, Benjamin Koetz, ESA



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Evapotranspiration and the Famine Early Warning System, Gabriel Senay, USGS

ET Mapping using ALEXI for Drought Monitoring, Martha Anderson, USDA ARS

12:00 – 12:30 Discussion and Questions

12:30 – 01:30 **Lunch**

01:30 – 03:00 **Interactive Poster Session**

Posters and interactive demonstrations from workshop speakers and other participants

03:00 – 03:30 **Break**

03:30 – 04:15 **Panel on Emerging Technologies: Opportunities and Challenges for International Applications**

Airborne Mapping of ET, Christopher Neale, Water for Food Inst., UNL

UAVs Applications for ET Mapping, Alfonso Torres, Utah State University

Small-Sats and ET Mapping, Darrel Williams, Global Science and Technology

EEFlux and Global ET Mapping, Ayse Kilic, University of Nebraska

04:15 – 05:15 **Discussion: Challenges in International Applications of ET Mapping and the Way Forward**

- Information access
- Emerging technologies and capabilities
- Ground-based infrastructure needs
- Capacity building
- Interfacing with programs

05:15 **Adjourn**



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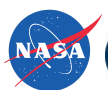
Day 3 Emerging Technologies / Summary and Recommendations

Room MC 2-800, World Bank

08:00 – 08:30 *Visitor badging and registration*

Session 1 – *What Might the Future Include?*

- 08:30 – 08:45 *Roles of Small-Sats for ET retrievals: Potentials and Limitations*, Darrel Williams, Global Science and Technology
- 08:45 – 09:00 *Roles of Piloted Aerial ET Retrievals in the Future*, Christopher Neale, Water for Food Institute, Univ. Nebraska
- 09:00 – 09:15 *Role of UAVs for Farm Management: From Crop Water Use to Fertilization to Canopy Volume and Yield*, Alfonso Torres, AggieAir, Utah State University
- 09:15 – 09:30 *UAV with Thermal Imaging for High Resolution ET and Water Stress Monitoring in Olives and Vineyards in Chile*, Samuel Ortega-Ferias, Univ. Talca, Chile
- 09:30 – 09:45 *Center Pivot Mounted Infrared Sensors: Retrieval of ET and Interface with Satellite Systems*, Paul Colaizzi, Susan O'Shannassey, USDA-ARS
- 09:45 – 10:00 *Cloud Computing Applications Panel*
- *EE Flux*, Ayse Kilic, University of Nebraska
 - *NASA Earth Exchange*, Forrest Melton, NASA ARC-CREST
 - *Climate Engine: Cloud computing and visualization of climate and remote sensing data*, Justin Huntington, Desert Research Inst.
- 10:00 – 10:15 *Improving the sustainability of agricultural water supplies in the US through a sustained and adequate remote sensing of ET system supported by sufficient field-scale satellite coverage: Considerations and implications for a national strategy*, Tony Morse, University of Idaho and Tony Willardson, Western States Water Council
- 10:15 – 10:45 Questions and Discussion
- 10:45 – 11:00 **Coffee Break**



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Session 2 – Community Recommendations and Next Steps

11:00 – 12:30	Discussion: <i>Recommendations and Next Steps</i> <ul style="list-style-type: none">• <i>Purpose of summary and recommendations</i>• <i>Presentation of straw man white paper and discussion</i>• <i>Identification of short-term opportunities and challenges</i>• <i>Community input on high priority needs to address existing challenges</i>• <i>Community input for workshop report relevant to the NRC Second Decadal Survey</i>
12:30 – 01:30	Lunch
01:30 – 02:45	Discussion: <i>Refinement of Recommendations</i>
02:45 – 03:00	Concluding Remarks and Adjourn



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